DOCUMENT RESUME

ED 060 582 EC 041 477

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TITLE Long Term Memory in Normals and Retardates.
INSTITUTION Temple Univ., Philadelphia, Pa.; Texas Univ., Austin.
SPONS AGENCY Social and Rehabilitation Service (DHEW), Washington, D.C. Div. of Research and Demonstration Grants.
PUB DATE [72]
NOTE 14p.

EDRS PRICE MF-$0.65 HC-$3.29
DESCRIPTORS *Cognitive Processes; *Educable Mentally Handicapped; *Exceptional Child Research; *Memory; Mentally Handicapped; Prediction; *Retention

ABSTRACT

The study sought to determine if relationships existed among Piagetian measures of reasoning and memory, and if development of the memory process in normals and retardates is identical. Subjects were 48 normals (IQ 90-110) and 48 retardates (IQ 50-75), all CA 8-20 years. A battery of assessments, including conservation, spatial imagery, and memory tasks, was presented on three recall occasions. The first time, an arrangement of geometric shapes was shown to subjects, who were then asked to draw the configuration from memory. One week and 6 months later, subjects were asked to draw from memory then reconstruct from a random assortment the configuration. While normals performed better on all recall occasions, over 6 months the rate of decrement on both memory assessments (reconstruction and evocation) was the same for both groups, suggesting that a short term memory deficit evidenced in immediate recall is the major differentiator between normals and retardates. Analysis also indicated that both Piagetian measures of reasoning and standard measures of intelligence (WISC or WAIS) added to the prediction of memory, with the Piagetian reasoning measures the most efficient predictors. (KW)

Long Term Memory in Normals and Retardates

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The present research has centered on the development of operatory thought and its relation to the memory process in normals and retardates. Interest was in the basic capacities and dispositions which the learner brings to the experimental situation and which determine the initial reception and storage of information subsequently to be recalled or retrieved. To this end the theories and techniques of Jean Piaget and his Genevan students and co-workers served as the context of this study. The investigator sought to determine (1) if relationships existed among Piagetian measures of reasoning and memory, and (2) if development of the memory process in normals and retardates is identical.

Two positions may be taken when the memory processes are investigated. Some researchers have hypothesized that memory is passive in nature. That is, memory is a recording organ through which information is recorded into a storage area. Perhaps the simplest example of this position was advanced by the British empiricist John Locke, who suggested that the mind is merely a blank tablet. The second position asserts that memory is an active process; the subject is like an historian who reconstructs the past when he is asked to relate past events.

The second hypothesis that memory is an active process has been selected for study in the present investigation. Specifically, the theory advanced by Piaget (1968), and Inhelder and Sinclair (1968) will be employed.

*This investigation was supported, in part, by Research Grant No. RD-2382-P from the Division of Research and Demonstration Grants, Social and Rehabilitation Service, Department of Health, Education, and Welfare, Washington, D. C. 20201.

According to Piaget memory is a system in which encoding, decoding and an intervening associative structure (code) are integral parts. It is the intervening structure or code that is of central interest to Piaget. Memory is considered to be a progressive organizing and reorganizing of reality by means of organizational structures (operations) which become extended and restructured as thought becomes more complex. The coding process is modified by this development and consequently is dependent upon it at any given time. That is, recall ability (behaviorally defined by accuracy or detail) depends on the level of cognitive development attained by the subject. Generally, if recall improves over a period of time Piagetian theory would suggest that the subject's coding process has improved because of progress in his operational development. Conversely, if there is no improvement in the quality of recall, then generally, there has not been the appropriate operational development.

From the above statements it can be seen that memory has two components - the figurative and the operative. Figurative aspects of memory are refered to by Inhelder (1969) as perception, imitation, and image formation. The operative memory component consists of actions or operations (thought processes). Perhaps the distinction between the figurative and the operative is better understood when one differentiates between a "scheme" and a "schema". Inhelder (1969) has defined a schema as being "merely a simplified imagined representation of a specific action" (p. 340). By contrast, a scheme is representative of a general operatory development - development which permits action on a variety of objects.

The Genevans propose that the figurative aspects of memory cannot explain memory by themselves; they are dependent on the individual's level

of operations. Forgetting, behaviorally defined as recall that is less representative of the initially viewed configuration, occurs when two conflicting schemes exist side by side. This conflict confounds the figurative component of memory and the reproduction quality suffers (Inhelder, 1969). The hypothesis may be interpreted to mean that if a subject is presented with an array of seriated sticks to memorize, and the scheme that would permit him to arrange objects in a series had not been achieved, then his recall of the array would suffer.

Studies reviewed tend to be supportive of Piaget's assertion that the child's representation of his world is dependent on the level of cognitive development at which the child is currently functioning. Thus, investigators who have attempted to replicate, constructive or otherwise, Piaget's initial studies into the memory processes of children have provided evidence which supports Piaget's claim that there is a positive correlation between the level of cognitive development a child has reached and his ability to recall a stimulus configuration. (Dahlen, 1969; Murray & Bausel, 1971; Dahlen, 1968; Stephens, Garrison, Anderson, & Cogan, 1970; Altemeyer, et. al., 1968).

SUBJECTS:

Forty-eight normal subjects (IQ 90-110; CA 8-20) and forty-eight retarded subjects (IQ 50-75; CA 8-20) were randomly selected from public schools in the Philadelphia area. The groups, normal and retarded, were further sub-divided into the following age ranges: 8-12, 12-16, and 16-20.

PROCEDURE:

Following Inhelder's approach to the study of reasoning, memory and mental imagery, a battery of assessments, including conservation, spatial

imagery, and memory tasks, was presented to subjects on three recall occasions. On the first occasion an arrangement of ovals, rectangles, and diamonds was shown to each subject. Immediately following presentation the subject was asked to draw the configuration from memory. One week later, recall was assessed by requiring that the subjects first draw and then reconstruct the original configuration from a random assortment of geometrical figures. Six months after the second presentation and again without viewing the configuration the subject was asked to first draw and then reconstruct the arrangement.

The reconstruction phase of the procedure was included so that some differentiation between evocative and reconstructive memory might be made. Evocative memory is defined as requiring some form of operational development, i.e., representational thought is necessary for reproduction. On the other hand reconstructive memory lies somewhere between recognitive and evocative memory. Through recognitory memory the subject will recognize the parts of the stimulus object when they are presented in a random assortment. Since elements must be arranged into the previously viewed configuration, thus requiring classificatory skills, evocative memory also enters into the task.

RESULTS:

Repeated measures analyses of variance were employed to determine if quality of recall increased as a function of time in normals and retardates (See tables 1 and 2). Results indicate that normals performed significantly better than retardates on all recall occasions (immediate, one week, and six months). However, an increase in recall scores over the six month period was not observed in either group (normals and retardates); signifi-

cantly lower scores were obtained as a function of time. Differences were significant in the retarded and normal subjects' performance at one week and six months. That is, scores at six months were significantly lower than scores at one week in both groups (see figures 1 and 2). Significant main effects for age which indicated that older children performed superior to younger children were noted only in the data derived from the memory drawing assessment.

Trend analyses revealed that in both normals and retardates a descending linear function best described the data. Tests of differences between the slopes of this function in both groups were not significant, i.e., normals and retardates in the present sample tended to show a diminution of performance at the same rate. (See figures 1 and 2.)

In an effort to establish the relationships between Piagetian measures of reasoning and memory three multiple regression analyses were accomplished (total group, normals, and retardates). Results of the analyses indicate that both Piagetian measures of reasoning and standard measures of intelligence (WISC or WAIS) added to the prediction of memory (reconstructive and evocative). It is important to note that in all three analyses Piagetian reasoning measures were the most efficient predictors.

CONCLUSIONS:

In retrospect, Piaget and his associates have suggested that memory is associated with the level of cognitive development. After an image is formed, recall of that image depends on the individual's level of cognitive development. With progression of time recall of the stimulus object will become clearer if there is a corresponding cognitive development. In the present study, results indicate that normals, who have

reached a higher level of cognitive development than the retardates, perform significantly better. However, neither group displayed growth over time in recall phases. Either significant cognitive development did not occur in the two groups or this development is not basic to the improvement of memory for the stimuli utilized in the present investigation. An alternative explanation of the forgetting might be that understanding of the relationships set forth in the configuration employed in the present study demanded a level of cognitive development not yet attained by the majority of subjects in this study. Thus, there was no foundation for growth.

In addition, the results suggested that loss of information over time is equivalent in normals and retardates. That is, there seem to be no differences in long-term memory in normals and retardates; a finding which has been substantiated by the majority of research in this area.

Results of multiple regression analyses revealed that a positive relationship exists between memory performance and Piagetian reasoning assessments. The finding suggests that memory is not a distinct area; rather it is one that is related to, if not dependent upon, reasoning ability as measured by the Geneva School.

PEDAGOGICAL IMPLICATIONS:

Additional research, rather than pedagogical implications, should follow from an exploratory investigation such as the present study. However, there are some implications for the teaching of exceptional children which do become evident from research of this type. The initial implication stems from the results of the multiple regression analyses. If memory performance is closely related to operatory

development, as the multiple regression data indicates, then educators should be cognizant of their students' current level of cognitive development before engaging them in any learning situation. Thus, a teacher might well expect a child to recall or reconstruct classroom materials that are relevant to his level of cognitive development.

Perhaps the most significant finding obtained in the analysis of the data derived from the performance of normals and retardates over the six month period was that the rate of decrement in scores on both memory assessments (reconstruction and evocative) was the same in normals and retardates. Stated differently, the results suggest that a short term memory deficit which is evidenced in the assessment of immediate recall is the major differentiator between normals and retardates. The differences between normals and retardates remained constant over the six month period. If retardates were able to retain information beyond the initial recall period, then the probability of retaining information would be equal to that of normals. Educational strategies should be directed toward developing more efficient methods which retardates could utilize initially in learning tasks.

An explanation for short term memory deficits has been advanced by Gallagher (1960) which may explain the findings derived from the present study. According to Gallagher, the findings of his study, which utilized retarded subjects, supported an increasing amount of research which suggested that short term memory is dependent on the number of chunks, or units, into which normals and retardates are able to organize information. Gallagher's findings suggest that organizational strategies do not mature until MA 12 is attained. Thus, it seems important for teachers to perform a type of task analysis when they attempt to provide learning

experiences for retarded children. That is, it is important to break down the task into as many unique units as possible and to present them in small manageable chunks. The present research indicates that these units should be commensurate with the individual's level of cognitive development, as might be measured by instruments such as those delineated by the previous speakers. Further, strategies such as mnemonics, which facilitate initial organization of information should be utilized.

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TABLE 1

ANALYSIS OF VARIANCE FOR NORMALS AND RETARDATES - DRAWING

Source of variation	SS	df	MS $\widetilde{(N)}$	F
Between subjects				
A (Normal/Retardate)	66.34	1	499.55	77.81 *
B (Sex)	.27	1	2.02	
C (Age)	8.75	2	32.94	5.13 *
AD	1.59	1	11.99	
AC	3.35	2	12.62	
BC	2.65	2	9.96	
ABC	1.75	2	6.59	
Errors (between)	539.55	84	6.42	
Within subjects				
R (Interval replicates)	36.74	2	138.34	48.80 *
AR	.04	2	.17	
BR	1.21	2	4.54	
CR	1.08	4	2.04	
ABR	.29	2	1.09	
ACR	2.83	4	5.33	
BCR	.45	4	.83	
ABCR	.30	4	.56	
Error (within)	473.86	168	2.88	

* $p < .01$

TABLE 2

ANALYSIS OF VARIANCE FOR NORMALS AND RETARDATES - RECONSTRUCTION

Source of Variation	SS	df	MS $(\tilde{N})$	F
Between subjects				
A (Normal/Retardates)	45.38	1	241.67	84.99 *
B (Sex)	2.11	1	15.91	3.95
C (Age)	2.74	2	10.30	
AB	1.17	1	3.31	
AC	2.97	2	11.18	
BC	.58	2	2.17	
ABC	1.26	2	4.75	
Error (Between)	350.94	87	4.02	
Within subjects				
R (Interval replicates)	17.61	1	132.63	56.20 *
AR	.83	1	6.24	
BR	.34	1	2.57	
CR	.66	2	2.50	
ABR	.00	1	.01	
ACR	.18	2	.69	
BCR	.30	2	1.12	
ABCR	.04	2	.17	
Error (Within)	205.58	87	2.36	

* $P < .01$

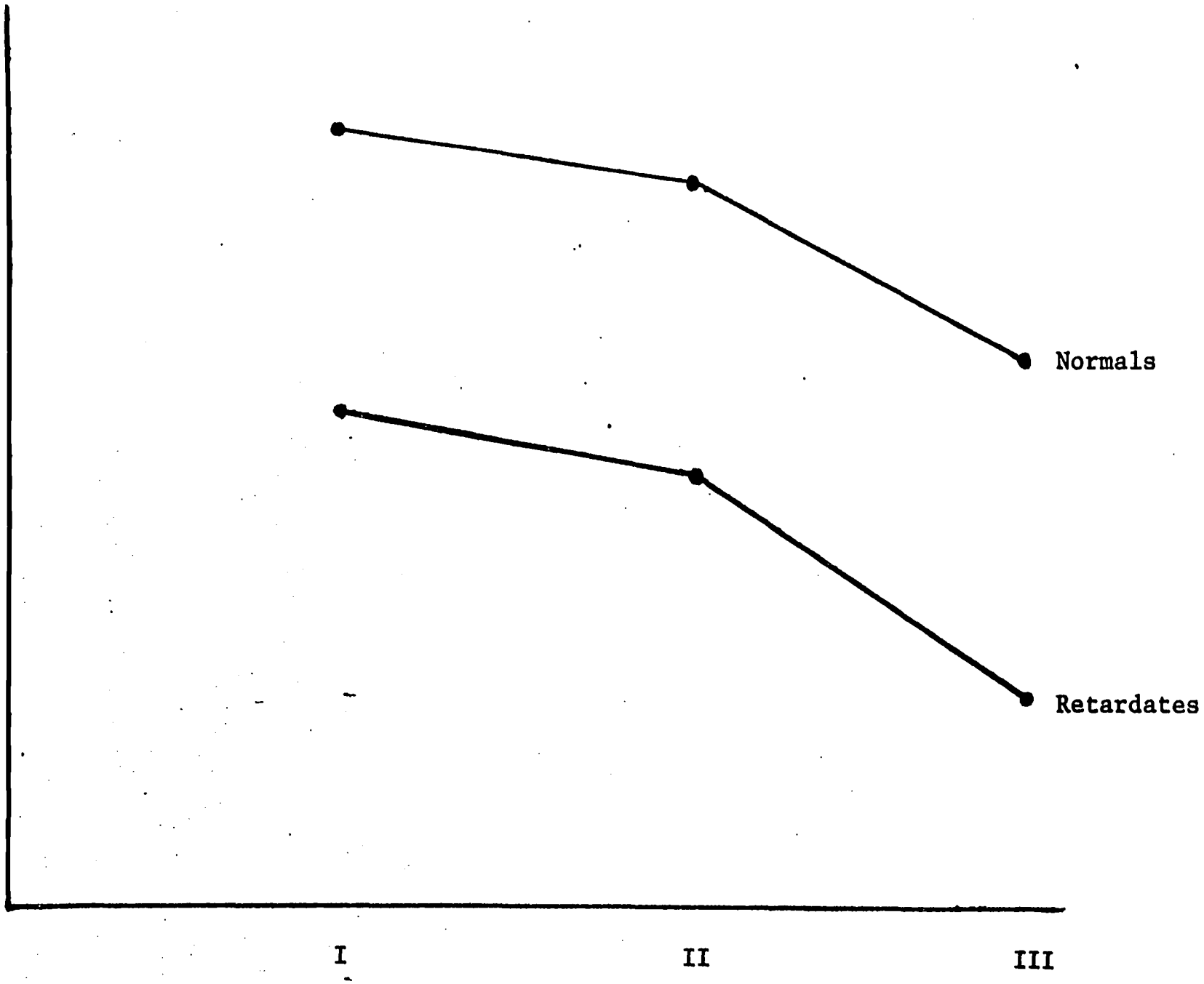

Figure 2

Mean performance for normals and retardates on memory drawing tasks - immediate (I), one week (II), and six months (III).

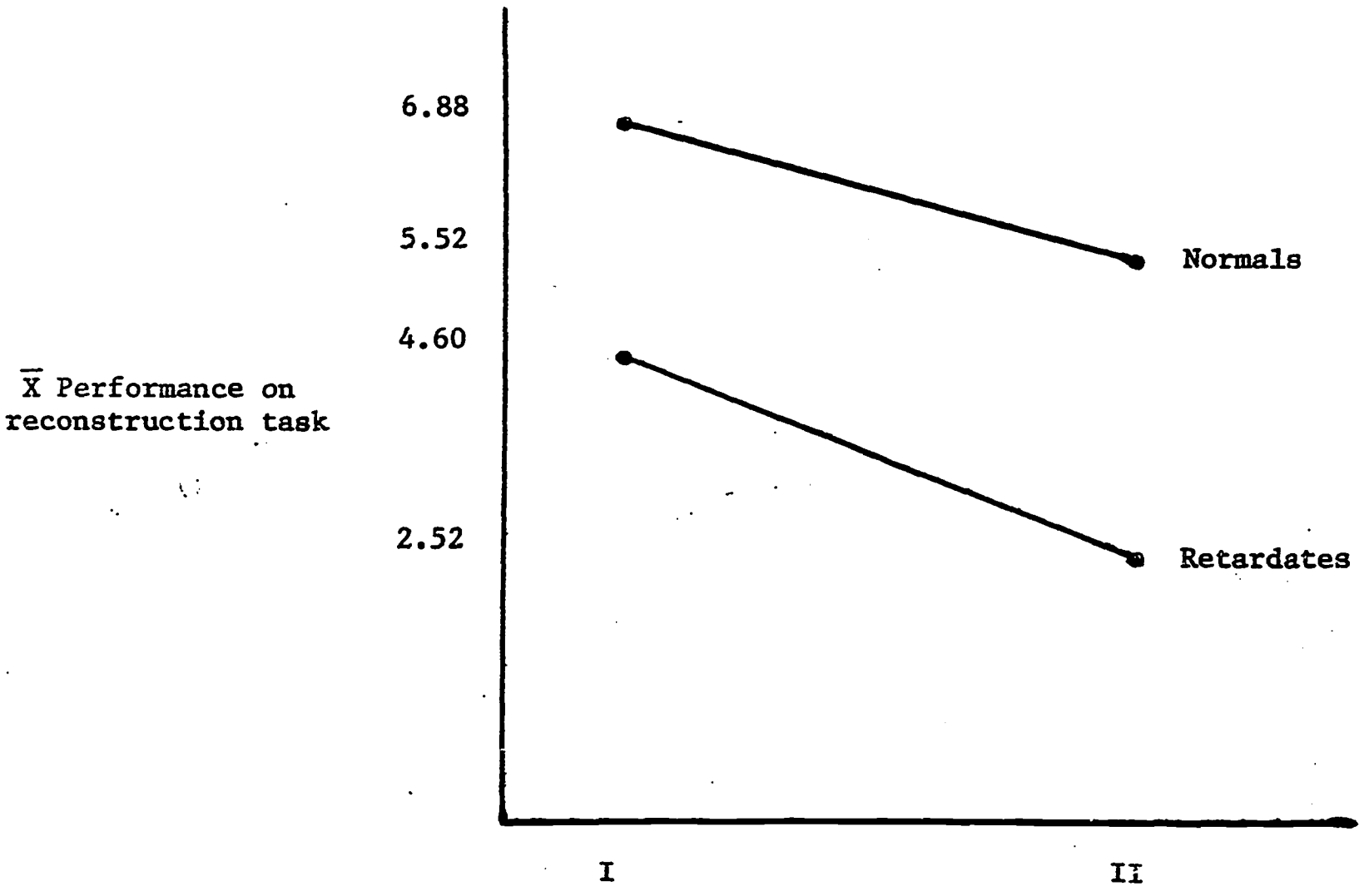

Figure 3

Mean performance for normals and retardates on the reconstruction tasks - one week (I) and six months (II).

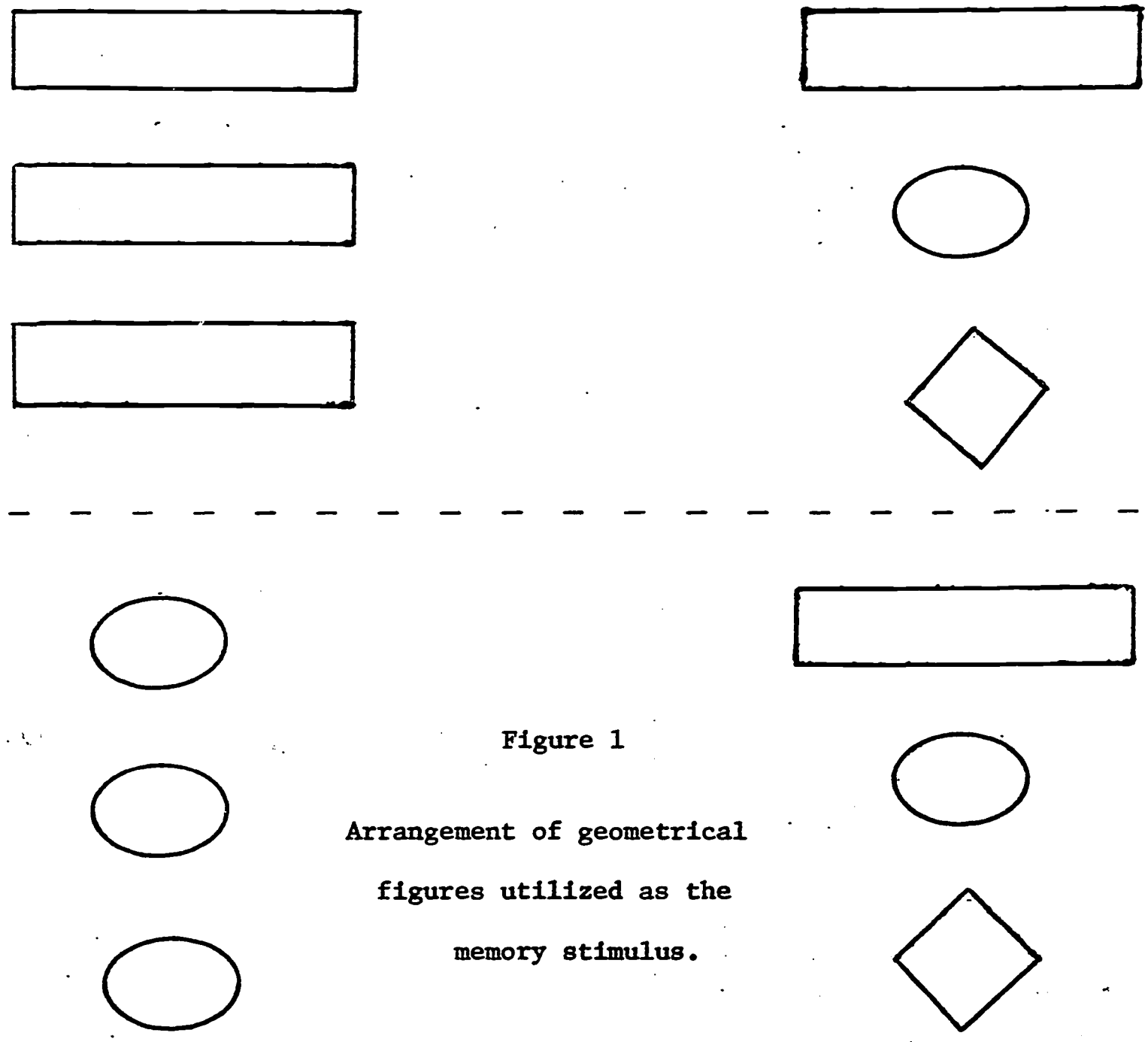

Figure 1

Arrangement of geometrical figures utilized as the memory stimulus.